Aquatic Management Indicator Species Report

Moonlight and Wheeler Fires
Recovery and Restoration Project

Mount Hough Ranger District
Plumas National Forest

Prepared By _____ **Date:** _6/10/09_
Kristina Van Stone Hopkins
Forest Fisheries Biologist

1. Introduction

The purpose of this report is to evaluate and disclose the impacts of the Moonlight and Wheeler Fires Recovery and Restoration Project (Moonlight-Wheeler Project) on the aquatic Management Indicator Species (MIS) benthic macroinvertebrates. Benthic macroinvertebrates were identified as MIS in the Sierra Nevada Forests Management Indicator Species Amendment (SNF MIS Amendment) Record of Decision (ROD)(USDA Forest Service 2007a). This report documents the effects of the proposed action and alternatives on the habitat of these MIS. A detailed description of the Moonlight and Wheeler Fire Recovery and Restoration Project alternatives are found in chapter 2 of the proposed project Revised Final Environmental Impact Statement (USDA 2009).

MIS are animal species identified in the SNF MIS Amendment ROD signed December 14, 2007, which was developed under the 1982 National Forest System Land and Resource Management Planning Rule (1982 Planning Rule) (36 CFR 219). The current rule applicable to project decisions is the 2004 Interpretive Rule, which states "Projects implementing land management plans…must be developed considering the best available science in accordance with §219.36(a)…and must be consistent with the provisions of the governing plan." (appendix B to §219.35). Guidance regarding MIS set forth in the 1988 Plumas National Forest Land and Resource Management Plan (PNF LRMP) as amended by the 2007 SNF MIS Amendment ROD directs Forest Service resource managers to (1) at project scale, analyze the effects of proposed projects on the habitat of each MIS affected by such projects, and (2) at the bioregional scale, monitor populations and/or habitat trends of MIS, as identified in the PNF LRMP (1988) as amended.

1.a. Direction Regarding the Analysis of Project-Level Effects on MIS Habitat

Project-level effects on MIS habitat are analyzed and disclosed as part of environmental analysis under the National Environmental Policy Act (NEPA). This involves examining the impacts of the proposed project alternatives on MIS habitat by discussing how direct, indirect, and cumulative effects will change the habitat in the analysis area.

These project-level impacts to habitat are then related to broader scale (bioregional) population and/or habitat trends. For benthic macroinvertebrates, effects to habitat are related to habitat trends at the bioregional (Forests in the Sierra Nevada) scale. The bioregional scale monitoring identified in the PNF LRMP, as amended, for MIS analyzed for the Moonlight-Wheeler Project is summarized in section 3 of this report.

Adequately analyzing project effects to MIS generally involves the following steps:

- Identifying which habitat and associated MIS that would be either directly or indirectly affected by the project alternatives; these MIS are potentially affected by the project.
- Summarizing the bioregional-level monitoring identified in the PNF LRMP, as amended, for this subset of MIS.
- Analyzing project-level effects on MIS habitat for this subset of MIS.

- Discussing bioregional scale habitat and/or population trends for this subset of MIS.
- Relating project-level impacts on MIS habitat to habitat and/or population trends at the bioregional scale for this subset of MIS.

These steps are described in detail in the Pacific Southwest Region's draft document "MIS Analysis and Documentation in Project-Level NEPA, R5 Environmental Coordination" (USDA Forest Service 2006a). This MIS report documents application of the above steps to select and analyze MIS for the Moonlight-Wheeler Project.

1.b. Direction Regarding Monitoring of MIS Population and Habitat Trends at the Bioregional Scale.

The bioregional scale monitoring strategy for the PNF's MIS is found in the SNF MIS Amendment ROD of 2007. Bioregional scale habitat monitoring is identified for all twelve of the terrestrial MIS.

- **MIS Habitat Status and Trend.**

Habitat monitoring for benthic macroinvertebrate data are collected and/or compiled at the bioregional scale, consistent with the LRMP as amended by the 2007 SNF MIS Amendment ROD (USDA Forest Service 2007a).

Habitat trend is the direction of change in the amount or quality of habitat over time. The methodology for assessing habitat status and trend is described in detail in the SNF Bioregional MIS Report (USDA Forest Service 2008). All habitat monitoring data are collected and/or compiled at the bioregional scale, consistent with the LRMP as amended by the 2007 SNF MIS Amendment ROD (USDA Forest Service 2007).

- **MIS Population Status and Trend.**

All population monitoring data are collected and/or compiled at the bioregional scale, consistent with the LRMP as amended by the 2007 SNF MIS Amendment ROD (USDA Forest Service 2007). The information is presented in detail in the 2008 SNF Bioregional MIS Report (USDA Forest Service 2008).

Population monitoring strategies for MIS of the Plumas NF are identified in the 2007 Sierra Nevada Forests Management Indicator Species (SNF MIS) Amendment ROD (USDA Forest Service 2007). Population status is the current condition of the MIS related to the population monitoring data required in the 2007 SNF MIS Amendment ROD for that MIS. Population trend is the direction of change in that population measure over time.

The current bioregional status and trend of populations and/or habitat for each of the MIS is discussed in the Sierra Nevada Forests Bioregional Management Indicator Species (SNF Bioregional MIS) Report (USDA Forest Service 2008).

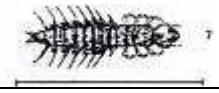
Aquatic Macroinvertebrate Status and Trend
For aquatic macroinvertebrates, condition and trend is determined by analyzing macroinvertebrate data using the predictive, multivariate River Invertebrate Prediction and Classification System (RIVPACS) (Hawkins 2003) to determine whether the macroinvertebrate community has been impaired relative to reference condition within perennial water bodies. This monitoring consists of collecting aquatic macroinvertebrates and measuring stream habitat features according to the Stream Condition Inventory (SCI) manual (Frasier et al. 2005). Evaluation of the condition of the biological community is based upon the RIVPACs generated O/E (observed/ expected) score, which is a reflection of the number of species observed at a site versus the number expected to occur there based on the RIVPACS model in the absence of impairment. Sites with a low O/E scores have lost many species predicted to occur there, which is an indication that the site has a lower than expected richness of sensitive species and is therefore impaired.

2. Selection of Project level MIS

Management Indicator Species (MIS) for the Plumas NF are identified in the 2007 Sierra Nevada Forests Management Indicator Species (SNF MIS) Amendment (USDA Forest Service 2007). The habitats and ecosystem components and associated MIS analyzed for the project were selected from this list of MIS. Table 1 below is taken from Table 1 of the Moon-Wheeler Project's MIS Report (Collins 2009). Please see that report for full project analysis of all Plumas NF MIS except aquatic macroinvertebrates. The Table discloses whether or not the habitat of the MIS is potentially affected by the Moonlight-Wheeler Project (4th column).

Benthic Macroinvertebrates are the only aquatic Management Indicator Species (MIS) identified in the 2007 Sierra Nevada Forests Management Indicator Species (SNF MIS) Amendment (USDA Forest Service 2007). As numerous streams are located within the Moonlight-Wheeler Project area, it is appropriate to evaluate direct, indirect and cumulative effects to habitat for this community.

Table 1. Selection of MIS for Project-Level Habitat Analysis for the Moonlight-Wheeler Project.

Habitat or Ecosystem Component	**CWHR Type(s) defining the habitat or ecosystem component**	**Sierra Nevada Forests Management Indicator Species *Scientific Name***	**Category for Project Analysis** *
Riverine & Lacustrine	lacustrine (LAC) and riverine (RIV)	aquatic macroinvertebrates 	3

* **Category 1:** MIS whose habitat is not in or adjacent to the project area and would not be affected by the project.

Category 2: MIS whose habitat is in or adjacent to project area, but would not be either directly or indirectly affected by the project.

Category 3: MIS whose habitat would be either directly or indirectly affected by the project.

3. Bioregional Monitoring Requirements for MIS Selected for Project-Level Analysis

3.a. MIS Monitoring Requirements.

The Sierra Nevada Forests Management Indicator Species (SNF MIS) Amendment (USDA Forest Service 2007) identifies bioregional scale habitat and/or population monitoring for the Management Indicator Species for ten National Forests including the Plumas NF (USDA Forest Service 2007). The habitat and/or population monitoring requirements for Plumas NF's MIS are described in the Sierra Nevada Forests Bioregional Management Indicator Species (SNF Bioregional MIS) Report (USDA Forest Service 2008) and are summarized below for the MIS being analyzed for the Moonlight-Wheeler Project. Habitat monitoring results for benthic macroinvertebrates are summarized in Section 5.

Bioregional Monitoring for aquatic macroinvertebrates: Index of Biological Integrity (IBI) and habitat condition and trend are measured by collecting aquatic macroinvertebrates, and analyzing the resulting data using the River Invertebrate Prediction And Classification System (RIVPACS) (Hawkins 2003) to determine whether the macroinvertebrate community has been impaired relative to reference condition within perennial water bodies. In addition, stream habitat features are measured according to the Stream Condition Inventory (SCI) manual (Frasier et al. 2005).

3.b. How MIS Monitoring Requirements are Being Met.

Habitat and/or distribution population monitoring for all MIS is conducted at the Sierra Nevada scale. Refer to the SNF Bioregional MIS Report (USDA Forest Service 2008) for details by habitat and MIS.

In addition, the Plumas National Forest has nine Stream Condition Inventory reaches within the Moonlight Wheeler fire boundary. Three of these reaches (Lone Rock Creek, Upper Lights Creek and Upper Moonlight Creek were selected for monitoring to first gather baseline data post the Moonlight Wheeler Fire Incident and then will be used for project implementation monitoring of the proposed Moonlight Wheeler Recovery and Restoration project. These reaches have been surveyed in the late summer of 2008 and will be monitored post project implementation and into the future to monitor recovery.

4. Description of Proposed Project.

A brief description of the proposed action is provided in this section. The proposed action and other alternatives are described in detail in Chapter 2 of the Moonlight and Wheeler Fires Recovery and Restoration Project Revised Draft Environmental Impact Statement (USDA Forest Service 2009).

The **Proposed Action (Alternative A)** would harvest fire-killed and fire-injured conifer trees from 14,755 acres within the analysis area. This includes approximately 4,389 acres of roadside hazard timber harvest. Specifically, merchantable trees (>16 inches dbh) would be felled, lopped and limbed, and removed utilizing helicopter logging systems and skyline logging systems on 6,219 acres. Within salvage units, merchantable fire-killed trees (>14 inches dbh) would be felled on 4,147 acres using ground-based logging systems. Trees less than 14 inches dbh within these units would be removed as biomass product. Within roadside hazard units, hazard trees greater than 10 inches dbh would be removed as sawlog product and hazard trees less than 10 inches dbh would be removed as a biomass product Temporary road construction of approximately 19 miles would occur with this action. Fourteen helicopter service landings would be constructed. Temporary roads and landings would be decommissioned, mulched or subsoiled afer project implementation. Reforestation, involving site prep and planting native conifer seedlings would occur across 16,006 acres of the analysis area. A detailed description of each action of the proposed action, including snag retention design, is in Chapter 2 of the Moon-Wheeler Project RFEIS (USDA 2009).

Project Design standards for all action alternatives include standards & guidelines identified in Table 2 of the Supplemental SNFPA (2004) Record of Decision, and the use of limited operating periods identified in Table 2.3, HFQLG FEIS (1999).

The **No Action Alternative (Alternative B)** would not implement the above actions to achieve the stated objectives. There would be no removal of fire-killed trees, no removal of roadside hazard trees, no road construction/reconstruction, and no site prep or reforestation.

Action alternative C of the Moon-Wheeler Project would harvest fire-killed and fire-injured conifer trees from 8,536 acres within the analysis area. This includes approximately 4,389 acres of roadside hazard timber harvest. Within salvage units, merchantable trees (>14 inches dbh) would be felled on 4,147 acres using ground-based logging systems. Trees less than 14 inches dbh within these units would be removed as biomass product. Within roadside hazard units, hazard trees greater than 10 inches dbh would be removed as sawlog product and hazard trees less than 10 inches dbh would be removed as a biomass product. Temporary road construction of approximately 18 miles would occur with this action. Temporary roads would be decommissioned, mulched or subsoiled afer project implementation. Reforestation, involving site prep and planting native conifer seedlings would occur across 9,306 acres of the analysis area.

Action alternative D of the Moon-Wheeler Project would harvest fire-killed and fire-injured conifer trees from 5,656 acres within the analysis area. This includes approximately 4,389 acres of roadside hazard timber harvest. Within salvage units, merchantable trees (>14 inches dbh) would be felled on 1,267 acres using ground-based logging systems. Trees less than 14 inches dbh within these units would be removed as biomass product. Within roadside hazard units, hazard trees greater than 10 inches dbh would be removed as sawlog product and hazard trees less than 10 inches dbh would be removed as a biomass product. Temporary road construction of approximately 3 miles

would occur with this action. Temporary roads would be decommissioned, mulched or subsoiled afer project implementation. Reforestation, involving site prep and planting native conifer seedlings would occur across 16,006 acres of the analysis area.

Action alternative E includes roadside hazard timber harvest and reforestation. Alternative E does not include salvage timber harvest or access activities. No new roads, skid trails, or landings would be constructed. Approximately 4,389 acres would be treated for roadside hazard removal. Hazard trees greater than 10 inches dbh would be removed as sawlog product and hazard trees less than 10 inches dbh would be removed as a biomass product. Reforestation, involving site prep and planting native conifer seedlings would occur across 16,006 acres of the analysis area.

Comparison of Alternatives

This section provides a summary of the effects of implementing each alternative. Information in the table is focused on activities and effects where different levels of effects or outputs can be distinguished quantitatively or qualitatively among alternatives.
Table 1. Comparison of Activities.

ACTIVITY	ALT. A	ALT. B	ALT. C	ALT. D	ALT. E
Acres of ground-based harvest	8,536	0	8,536	5,656	4,389
Acres of skyline salvage	872	0	0	0	0
Acres of helicopter salvage	5,347	0	0	0	0
Acres of planting	16,006	0	9,306	16,006	16,006
Miles of temporary road construction	19	0	18	3	0

Project design Standards

Project design elements **(USDA 2009 -** Moonlight and Wheeler Fire Recovery and Restoration Project Revised Draft Environmental Impact Statement pgs. 10-36), equipment restriction zones (Ibid), Best Management Practices [BMP's, (Table C-1)] and Standard Management Recommendations [SMR's] Appendix C of RFEIS) will be implemented with the action alternatives A, C, D, and E. These design standards are designed to minimize habitat degradation by project implementation and protect or enhance down stream water quality.

Road Management

Numerous integrated design features are included in the project to reduce risk of adverse impacts to soil, water, riparian and aquatic resources (Pgs. 10-36 of RDEIS). Primary among these measures are designation and management within areas adjacent to streams, meadows, and other wetlands referred to as Riparian Habitat Conservation Areas (RHCAs- Appendix L, HFQLG FEIS). RHCAs are managed differently than the rest of the landscape. In these areas, treatments are designed to ensure that riparian management objectives (RMOs) are met (Moonlight and Wheeler Fire Recovery Project Record, 2008) Integrated Design Features are fully explained in the proposed action for the project. Key

features include inner and outer zones within RHCAs. Within inner zones, landing and skid trail construction is not permitted.

Cumulative effects at the bioregional scale are tracked via the SNF MIS Bioregional monitoring, and detailed in the SNF Bioregional MIS Report (USDA Forest Service 2008).

Analysis Area for Project-level Effects Analysis:

The wildlife aquatic analysis area is defined as the 87,647 acre area (68,408 acres or 78 percent is NFS lands) where the Moonlight and Antelope Complex fires burned. The analysis area is located in predominately Sierra mixed conifer forest habitat ranging in elevation from 3,800 feet in the North Arm of Indian Valley to 7,500 feet at the top of Eisenheimer Peak. The analysis area is largely along the cusp of the Transition and Eastside ecological zones (USDA 1999). This perimeter contains 68,408 acres or 78 percent National Forest Lands with the exception of 82 acres of spot fires which occurred outside of the main fire perimeters. This analysis area was chosen for the following reasons: 1) proximity and adjacency of these two fires and similar severity effects has had a major effect on the landscape. 2) The proposed actions would treat and modify burned areas only. Therefore, selection of the total area that burned within both fires for analysis provides a more appropriate context for reasonable determination of effects to habitat (and the species associated with this habitat) proposed for treatment. 3) Relevant cumulative effects, particularly other projects that have or will treat burned habitat resulting from the two fires, are more effectively addressed. 4) The impacts to habitat as a result of the wildfires and the effects from cumulative actions within this burned landscape are not diluted by expanding the analysis area boundary to include larger parcels of unburned habitat outside the wildfire boundary. 5) The aquatic analysis is the same as the hydrologic analysis area (Cumulative Watershed Analysis [CWE]) and includes the subwatershed affected by the proposed action.

Effects to aquatic macroinvertebrate habitat by the proposed management actions were considered at multiple scales. On site impacts of activities to soils and streamside areas were considered. Indirect impacts to stream habitat was considered at the scale of the sub-watersheds within the project area (listed in Table 1). Cumulative effects were considered at both the sub-watershed scale, and the larger scale of the CWE Analysis Area which includes twenty-six Huc 6 sub-watersheds (Table 101 of Moon-Wheeler RDEIS), analyzing the downstream effects of all project alternatives (USDA 2009). Finally, project level effects are related to habitat trends at the bioregional scale.

The responses to the key factors (as described below) identified for riverine habitat would be affected by wildfire. As with numerous studies (included in Roby & Azuma 1995, and in Minshall, 2003), it is expected that stream temperatures, stream flows and nutrient levels will all increase in the short term, and that long term increase in sediment production and deposition will occur. For the purpose of the aquatic wildlife analysis partial recovery will occur quickly (1-5 years), species diversity will be higher than pre-fire but species richness would be lower, and long term recovery of the macroinvertebrate

community may take 10-50+ years. With salvage logging, the timeframes for recovery may be extended. Recovery of stream ecosystems from the effects of fire is likely to be slower, more sporadic, and potentially incomplete in cases where natural process is impaired (Minshall, 2003). Rapid recovery of stream macroinvertebrates is associated with the more rapid recovery of the riparian vegetation (Ibid).

Current Condition of the Key Habitat Factor(s) in the Analysis Area

Stream Channel Conditions

There are 790 miles of channel in the project area, including 604 miles of ephemeral, 80 miles of intermittent and 106 miles of perennial according to Forest GIS records. Reference appendix A, Table 1 for the existing stream condition (SCI reaches) and Appendix B Table 1 & 2 for the existing macroinvertebrate composition and evaluation prior to the Moonlight and Wheeler Fires in the project area.

Antelope Lake is located at the north eastern edge of the project area, but the treatment units for fire-killed or hazard tree removal and reforestation are all located to the west and/or downstream of Antelope Lake, thus this lacustrine habitat is not affected by the action alternatives (Moser 2009).

Twenty-one of 26 analysis area watersheds within the aquatic analysis area are over thresholds set by the Forest, for management impacts that affect runoff, all but one are due to the effects of the fire (Table 104 of RFEIS). The exception, Moonlight Pass watershed is currently over threshold because of fire salvage harvest on private land. Seven of the watersheds determined over TOC are so in excess of 20 percent (highlighted in table 1 below) and it is reasonable to expect that under conditions of intense precipitation events sections that significant increases in runoff would occur. These watersheds are Indian below Bear Valley, Lonesome Canyon, Mid Lights Creek, Moonlight Pass, Morton, Smith and the West Branch of Lights (Moser 2009).

About 27 miles of channel, mostly ephemeral and intermittent in nature, have been surveyed by the project hydrologist, for indication of flow regime and function, such as bank stability and amounts of Large Woody Debris (LWD). Most of the survey reaches are in Pierce and Upper Indian creeks drainages with minor amounts in Cold Stream, Middle Lights Middle Creek, Moonlight and Moonlight Valley (Forest GIS records). About 6 percent of the total surveyed reaches or 1.6 miles had prevalent or extensive bank instability, primarily in Upper Indian Creek, and almost entirely within ephemeral and intermittent channels. About 1.4 miles of channel, all intermittent or ephemeral in nature were listed in the survey as having poor, inadequate amounts of LWD. All these reaches were in Middle and Upper Indian creek drainages (Moser 2009).
Fire burned out the LWD in most channels, particularly first and second order streams. Sediment stored by LWD may be released, as well as new deliveries of sediment including ash may be freed to transport downstream (Faust, 2007). In the larger channels LWD was only partially consumed. Burned trees on the banks have fallen into streams creating flow deflector that may divert water into stream banks create more erosion as well as destabilizing the banks themselves (Rosel et al. 2007). In contrast, water could be

deflected away from the banks and the additional LWD could stabilize the banks. Observation during field visits for this report was that those reaches within meadow areas were relatively untouched, and the burn severity was light on the meadow floodplain. Reaches in gorges such as lower Lights Creek with large areas of out cropping were also only lightly burned.

Stream condition inventory (SCI) attributes and macroinvertebrate metrics were evaluated to qualify streams with data collected as good, moderate and poor (Appendix_A, Table 1). SCI's have been conducted on, Little Antelope, Antelope, Clark's, Stream, Moonlight, Lights and upper and lower Boulder Creeks. The SCI data and Rapid Bioassessment data are reviewed together the following metrics (%fines, substrate size, residual pool depth, temperature, stream cover, and aquatic macroinvertebrate metrics) prior to the Moonlight and Wheeler Fires.

Of the stream inventoried; Moonlight Creek, Boulder, Cold Stream and Hungary Creeks received an overall SCI condition rating (Appendix A, table 1) of moderate. The percentage of sediment in pool tails were good and the percentage of unstable banks were vulnerable. Shade was also rated as moderate to good. The current condition post fire for all drainages is moderate to poor due to loss of riparian vegetation. Last Chance, Clark's Creek, Little Antelope and Pierce Creek were rated at moderate to poor. Shade was collected at only Clark's creek and was rated as poor. Sediment in pool tail fines was high in both reaches, which rated at poor to very poor. Current and Historic grazing activity has occurred around both reaches, and may have contributed to high sedimentation, low shade and unstable banks within these four drainages. The overall rating of aquatic macroinvertebrate metrics for Antelope, Boulder, Moonlight, Hungary, Indian and Coldstream Creeks of moderate to good, and for Last Chance, Clarks, and Little Antelope Creeks of moderate to poor. Again, this was the overall condition of these streams prior to the Moonlight/Wheeler fires.

Cooks, Moonlight, Lights and Indian Creeks had or have mining in or near the streambeds. Mining disturbed riparian areas and channels, creating at the very least over-steepened and unstable stream banks.

There is a confluence of many streams to form the main stem of Lights Creek: West Branch Lights Creek, upper Lights Creek, Bear Valley Creek, Morton Creek, Smith Creek, Fant Creek and East Branch Lights Creek channels in this area are broad and mobile with cobble/boulder dominate beds. Channels upslope of the confluence are steep with unstable banks. Prominent terraces have developed along Morton Creek immediately upstream of its confluence with East Branch Lights Creek. These features indicate that accelerated post-fire erosion and sedimentation is likely to increase channel instability and bank erosion in this area. The main channel of Lights Creek is likewise unstable with high sediment loading and a braided cobble-dominated channel for approximately one mile downstream of the confluence area. Abundant mine tailings and debris are present on the banks and in the channel. The channels of Moonlight Creek and its tributaries were fairly stable, though some areas of Moonlight Valley appear degraded.

Middle Lights Creek is dominated by placer mining activity and the channels are degraded, and tailing piles cover banks and floodplains (Faust 2007).

The Aquatic Analysis for the Burn Area Emergency Rehabilitation Report identified all of middle and lower Lights Creek, east and west branch Lights Creek, Moonlight Creek, Smith Creek, Fant Creek, Lone Rock, Willow and Upper and West Indian, Little Antelope, Clark's Creeks, and Cold Stream as primary concerns for the potential to move sediment into the stream system due to moderate to high severity wildfire adjacent or upstream or upslope of these drainages again due to steep long slopes, loss of riparian vegetation, and post - timber harvested on private land ownership (Hopkins, 2007). Mastication and mulching treatments were proposed under BAER to moderate the expected increase in sediment delivery to the streams (Faust 2007). The tributary channels of Upper Lights Creek watersheds by contrast are steep and dominated by cobbles and boulders and appear to be stable.

Willow Creek just below the headwaters flows through a stringer meadow in which a prior pond/plug restoration project failed and now there is a large gully of unstable soil perched above a transport section of Willow Creek channel and its tributaries which appear to be stable, armored as they are by large substrate or vegetation. Similarly, the main channel and tributaries of Pierce Creek, and Indian Creek are composed mostly of cobbles and boulders and appear stable.

The analysis of SCI data, aquatic macroinvertebrate metrics (appendix A, appendix, table 1) and field visits; findings are the predominance of the perennial streams within the analysis area are in moderate to low condition of primary concern due to the potential to move sediment into the stream system due to moderate to high severity wildfire adjacent or upstream or upslope of these drainages, steep long slopes, loss of riparian vegetation, and post - timber harvested on private land ownership (Hopkins, 2007).

Three additional SCI monitoring sites (Upper Moonlight, Upper Lights, and Lone Rock Creek) have been developed and surveyed post Moonlight/Wheeler Fires in the summer of 2008. The winter of 2007/2008 was a low water year and very little channel maintenance occurred. It was noted that riparian vegetation was flourishing, with much more open conditions due to the loss of conifer cover on Lights and Moonlight Creek. These SCI reaches are in process of being surveyed in August and September of 2008. Macroinvertebrate samples are sent to a lab and data will be available in the early summer of 2009.

Summary of Aquatic Macroinvertebrate Status and Trend at the Bioregional Scale
The Plumas NF LRMP (as amended by the SNF MIS Amendment) requires bioregional-scale Index of Biological Integrity and Habitat monitoring for aquatic macroinvertebrates; hence, the lacustrine and riverine effects analysis for the Moonlight-Wheeler Project must be informed by these monitoring data. The sections below summarize the Biological Integrity and Habitat status and trend data for aquatic macroinvertebrates. This information is drawn from the detailed information on habitat

and population trends in the Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2008), which is hereby incorporated by reference.

Habitat and Index of Biological Integrity Status and Trend. Aquatic habitat has been assessed using Stream Condition Inventory (SCI) data collected since 1994 (Frasier et al. 2005) and habitat status information from the Sierra Nevada Ecosystem Project (SNEP) (Moyle and Randall 1996). Index of Biological Integrity is assessed using the River Invertebrate Prediction and Classification System (RIVPACS) and macroinvertebrate data collected since 2000 (see USDA Forest Service 2008, Table BMI-1). These data indicate that the status and trend in the RIVPACS scores is stable.

5. Effects of Proposed Project on the Habitat for the Selected Project-Level MIS.

Lacustrine/Riverine Habitat (Aquatic Macroinvertebrates)

Habitat/Species Relationship.
One of the two MIS carried forward in the RFEIS is benthic macroinvertebrates for riverine and lacustrine habitat in the Sierra Nevada. Benthic Macroinvertebrates (BMI) were selected as the MIS for riverine and lacustrine habitat in the Sierra Nevada. They have been demonstrated to be very useful as indicators of water quality and aquatic habitat condition (Resh and Price 1984; Karr et al. 1986; Hughes and Larsen 1987; Resh and Rosenberg 1989). They are sensitive to changes in water chemistry, temperature, and physical habitat; factors of particular importance are: flow, sedimentation, and water surface shade. For macroinvertebrate analysis, rapid bioassessment data collected within the analysis area has been analyzed to determine local biotic conditions. Stream Condition Inventory data was also analyzed to determine the pre-fire condition of streams within the analysis area (Appendix A, Table 1).

Benthic macroinvertebrates are invertebrates that live in water and can be seen by the unaided human eye. They provide an important ecological link between microscopic food organisms and fish. Benthic macroinvertebrates include insects, such as the commonly thought of mayflies, stoneflies, caddisflies, helgrammites and midges. Many of these groups are most highly developed for running water environments with adults and larvae living primarily in cold, running streams; many feed and breed under rocks, in the spaces among loose gravel and rocks, piles of waterlogged leaves and debris, and submerged logs.

Habitat factors utilized for this analysis include: flow; sedimentation; and water surface shade (water temperature). In addition, large woody debris (LWD) was identified as an issue to maintain quality habitat for cold water fisheries and macroinvertebrates.

Project-level Effects Analysis – Lacustrine/Riverine Habitat

Again, stream condition inventory measurements were evaluated determine the current condition, any potential changes in these habitat factors by the proposed action.

Sedimentation is measured by pool tail fines, and the Whoman pepple count (D50), water temperature was measured by stream surface shade and thermorgraph temperatures (appendix A, table 1), flow is qualified by the current type of stream (ephemeral, intermittent, and perennial) and if there is the potential for this stream to change and thus showing any changes in flow. Indicators used to analyze the effects to water quality by the proposed Moonlight-Wheeler Project on macroinvertebrate habitat are Equivilent Roaded Area (ERA) and Threshold of Concern (TOC) values by HUC 6 sub watersheds (Fig.1, table 1, Appendix A, table1), Riv Pac O/E scores, and aquatic macroinvertebrate metrics (Appendix B, table 1 & 2).

Methods for cumulative watershed effects analysis are described in the project's watershed report (Moser 2009). Equivalent roaded acres (ERA's) serve as an index to measure the impact of past, present, and future land management activities on downstream water quality. Watersheds and their associated stream systems can tolerate given levels of land disturbance, but there is a point when land disturbances begin to substantially impact downstream channel stability and water quality. This upper estimate of watershed "tolerance" to land use is called the threshold of concern (TOC). Above the TOC water quality may be impaired such that the water is no longer available for established beneficial uses, such as municipal water supplies or irrigation, or no longer provides adequate habitat for fisheries. The threshold of concern serves as a "yellow flag" indicator of increased risk of significant adverse cumulative effects occurring within a watershed. The TOC for the Moonlight/Wheeler analysis area is **12-14** (pers. comm. E. Moser, 2009).

Habitat Factor(s) for the Analysis: Flow; Sedimentation; and Water surface shade (water temperature)

Current Condition of the Key Habitat Factor(s) in the Project Area:

Effects from the project on three processes were considered:

Reduced flows- as a result of changes in flow regime, lower flows could result in a permanent or temporal "drying" of existing habitat.

Increased sedimentation- An increase in delivery of sediment to channels could decrease RIVPACS scores by elimination of sensitive taxa and reduction in taxonomic richness.

Changes in temperature regime- Temperature changes resulting from canopy removal or changes in flow regime could affect timing of life history activities, such as breeding and migration, or affect abundance and distribution of sensitive taxa.

Effects:

The following section assesses effects on benthic macroinvertebrate habitat. Detailed information on benthic macroinvertebrates is documented in the SNF Bioregional MIS Report (USDA Forest Service 2008), which is hereby incorporated by reference.

Approximately 75% of the analysis area burned at high to moderate severity, due to the complete removal of vegetation. Recovery potential depends on erosion after wildfire as groundcover re-establishes with vegetation growth. Erosion risk reduces dramatically as groundcover returns, estimating 3-5 years from the BAER report (Rosel et al. 2007). Two complicating factors are limited natural regrowth within high severity burn areas and the high chance of flooding events, mainly rainfall intensity is a primary driver for erosion, especially in a burned landscape (Moser et at., 2008 in Spigel and Rovichaud 2006), the saturated conditions are likely to produce shallow surface movement of soil from extreme rain on snow events (Moser 2009).

The occurrence of heavy rain and warm and breezy conditions in mid-winter is popularly referred to as the "pineapple express" because of the point of origin of these systems in the South Pacific Ocean near the Hawaiian Islands. These conditions can be present during El Nino episodes, but the latitude of the analysis area puts it between El Nino and La Nina influenced zones, and makes the correlation somewhat problematic (Barkhuff, 2008, personal communication). Most importantly is the frequent occurrence of warm and moist tropical air from the southwest moving over the Sierra Nevada Mountains in mid-winter when a thick blanket of snow may be already present. A further condition that certainly exaggerates this effect locally, and perhaps is a very significant factor, is the southwest aspect of the Lights Creek headwaters area roughly above the 5,000 foot elevation that is also the principle catchment area for the stream (Moser 2009).

Action Alternatives: Alternatives A (Proposed Action), C, D, and E

The proposed actions calls for harvest of Riparian Habitat Conservation Areas (RHCA) to the extent outlined in Design Features section and in Appendix C of the RFEIS.

Direct and Indirect Effects

Direct and Indirect Effects to Habitat.

Middle Creek, Lower Indian Creek, Fred's Creek, Superior Ravine, East Branch of Lights Creek, Lights Creek, and Moonlight Creek are perennial streams that would be directly impacted by fire-killed tree removal under Alternative A as it is within a helicopter Unit. Felling and tree removal is proposed to occur within ten feet of the perennial stream channel. These streams would be helicopter logged under Alternative A and would not be logged with Alternatives C, D, and E. Design standards include retention of four of the largest snags per acre and implementation of the SAT guidelines (USDA 2004b, page 67; USDA 2003, Appendix L, pages APP L 9 – APP L 12), equipment restriction zones, Best Management Practices ([BMP's] and Standard Management Recommendations [SMR's] (Appendix C of RDEIS) within all RHCA's. Sedimentation into the stream channels should be minimal unless a rain on snow event occurs within the five years post fire (see discussion in cumulative effects section.

Tractor harvest is proposed adjacent to China gulch, Lights, Fant, Bear Valley, W. Branch Lights, Moonlight, Middle Fant, and Sage Creek. Skyline harvest methods

(Alternative A only) are proposed on Moonlight, Bear, Morton, W. Branch Lights, and Hungary Creeks. Again, project design standards and equipment restrictions have been developed to minimize soil disturbance and sedimentation into drainages (Pgs. 10- 26 and Appendix C of RFEIS).

The confluence of similar third order watersheds at the top of the Middle Lights Creek project watershed creates in itself a heightened risk for flooding on and downstream of this watershed. An aggravating circumstance is the heavy logging on private lands in the headwaters of Upper Lights, West and East Branch Lights and Smith Creeks, the principle contributors to Lights Creek.

Evaluation of Elements

Flow: Streams within the Moonlight/ Wheeler Aquatic Analysis area are not expected to change flow due to the implementation of the action alternatives. Changes in stream flow, above the levels that may have increased due to vegetative removal by fire, are not expected to increase with removal of fire-killed or hazard trees. For example all perennial streams are expected to remain perennial, all intermittent streams are expected to remain intermittent and the same for ephemeral streams. Flow will change depending on the water year. There is expected to be a minimal change in the TOC/ERA values by the implementation of each action alternative (Table 101 of RDEIS) and the greatest effect to flow will be within those twenty-one of the twenty-six subsheds analyzed that are currently over threshold prior to the implementation of action alternatives and will remain over threshold. "Overland flow can be initiated when surface infiltration capacity is drastically reduced. The effect of wildfire in the event of high intensity rainfall is comparably much higher than roads or harvest"(Moser 2009). "The overwhelming effect to hydrologic function, in any of the alternatives, is that of cover loss and potential for widespread overland flow. With a high water event there would be potential for a debris flow to occur within the stream courses in those subwatersheds (table 101 of RDEIS). There are twenty-four perennial streams within the aquatic analysis area. The streams of concern are discussed above. The existing flow condition should remain the same post fire unless large water event occurs thus impacting the existing macroinvertebrate habitat.

Most importantly is the frequent occurrence of warm and moist tropical air from the southwest moving over the Sierra Nevada Mountains in mid-winter when a thick blanket of snow may be already present . A further condition that certainly exaggerates this effect locally, and perhaps is a very significant factor, is the southwest aspect of the Lights Creek headwaters area roughly above the 5,000 foot elevation that is also the principle catchment area for the stream. Therefore, over the next 3 to 5 years until sufficient ground cover is re-established there is a high risk of a large floods downstream of the analysis area, particularly within the Lights Creek drainage. Because of the effective lack of ground cover a flood could be potentially much larger than previous to the fire, with the same return interval of rainfall.

Temperature: The wildfire consumed both riparian and conifer vegetation that provide surface water shade. Thus up to 100 percent of existing vegetation providing shade has

been removed. No live vegetation currently providing minimal shade would be removed by the action alternatives, thus no immediate change in water surface shade is expected. Fire-killed trees provide a minor amount of shade, thus some structural shade would be removed, but amount of shade provided by fire-killed trees is much less than prior to the fire and probably not very influential in terms of water temperatures. There would be some loss of large diameter snags adjacent to the perennial streams within helicopter units, yet the retention of four of the largest snags per acres within these RHCA's would minimize this effect. Large woody retention/recruitment within RHCAs of perennial and intermittent streams would result in a large flush of woody material over the next 10 years and then no recruitment for the next 50+ years. Vegetative response post fire by riparian species would help recover surface water shade within two-five years (Moser 2009).

Water temperature has the potential to warm up slightly within the helicopter and skyline units proposed under Alternative A due to removal of large diameter trees that provide some shading to the stream. This effect would be indirect and should be minimal. In addition within the tractor units proposed under Alternatives C and D; areas outside of the snag retention zones would be devoid of all snags greater or lesser than 14 inches dbh and thus any shade larger diameter snags provide would be lost. There is the potential for increased temperatures due to lack of forested or "snag" cover in the short term, and increased conifer cover in the long term (10-15 years) with the growth of the planted conifers throughout the units harvested. The potential for a short term increase in temperature could affect the timing of life histories of sensitive aquatic macroinvertebrates.

Planting conifers throughout the proposed treatment units under all alernatives will provide shade to the streams in the future and ultimately reduce stream temperatures. Acres of reforestation proposed under Alternatives A, D, and E are the same – 16,006 acres. Alternative C proposes to treat significantly less – 9,306 acres. With the no ation alternative, conifers will not be planted within the fire boundary.

Erosion from harvest slopes, and subsequent sediment delivery to channels is expected to be elevated over normal conditions because of lack of ground cover. But in the event of precipitation that initiates erosion the overall lack of ground cover on burned slopes would be the greater source. Harvesting creates areas of compaction and displacement of soils, leading to localized incidences of overland flow, but BMPs, PNF LRMP guidelines and regional soil productivity guidelines would limit detrimental disturbances to soil to 15 percent or less of a treatment unit. The treatment units do not constitute the majority of slope area (Moser 2009).

Sediment delivery to streams is related to the cumulative watershed effects analysis (Moser 2009), and findings are that there is little difference between the action alternatives and the no action alternatives due to the adverse effect of the wildfire. Twenty-one of the twenty six sub-sheds analyzed are at or over the threshold of concern. All but one watershed over threshold are due to the effects of the fire (table 1). The impacts of **all** action alternatives would not be higher than that of the wildfire, though the

salvage activities would prolong natural recovery from 2 to 5 years (Moser 2009). "The steep slopes, though more erosive, would return to natural fire recovery within two years, while the shallow slopes where ground based systems are used would return to natural fire recovery within 3-5 years. Slope restrictions for ground based harvest under 25 percent slope, which include areas within granitic soils, RHCA, and roadside hazard removal, would variously lower erosion potential for all action alternatives. " (Moser et al., 2008). .

Harvesting creates areas of compaction and displacement of soils, leading to localized incidences of overland flow, but BMPs and Forest Plan standards are that such disturbances are no more than 15 percent of a treatment unit. And units in themselves do not constitute the majority of slope area. **Therefore actual harvest effects are a relatively minor proportion of the watershed** (Moser 2009). Harvesting trees as proposed in the action alternatives will have some increase in sedimentation, yet this impact is minimal and should not change the existing post fire taxa.

An additional and significant proportion of proposed harvest is in the Moonlight Creek drainage, which confluences with Lights Creek at the bottom end of the Middle Lights Creek sub-watershed. Further, the Middle Lights Creek is an epicenter of sorts for high burn severity. These factors in themselves would create high expectations of runoff increase downstream and within the Middle Lights Creek sub-watershed (Moser 2009). Sediment production from harvest is also mostly tied to access roads with several fold increases (multiplicative factors of 2 and 3) measured from 1 to 5 years after completion of harvesting, before a return to near baseline or pre-activity condition (Krammes and Burns 1973; Rice et al. 1973; Beschta 1978; Keppeler and Ziemer 1990). Primary sources are running surfaces, cut banks, and fill slope failures, the latter which usually come a few years after road construction. Roads, though a steady and non-diminishing source of runoff effect are a minor one in the analysis area, accounting for 1 to 2 percent ERA across the watersheds (Moser 2009).

Treatments in all action alternatives include snag retention areas and snag recruitment within RHCAs both of which retain snags that would serve as recruitment for coarse woody debris (See tables 4.2, 4.7, and 4.8 of the vegetation report, Tompkins 2009). The equipment exclusion zones within the RHCA retain sufficient quantities of standing dead trees for future recruitment and within 10 years predicted LWD is greater than 10 tons per acre, in addition four of the largest snags per acre would be retained in the RHCA's, preferably within falling distance of the channel where available, to provide for large down woody debris recruitment to best meet riparian management objectives. Within ground-based salvage harvesting treatments, snag retention in RHCAs would be most preferable and efficient within equipment exclusion zones where snags would be within reasonable falling distance of the channel for coarse woody debris recruitment and harvesting safety issues would be minimized due to equipment exclusion.

Average tons per acre of coarse woody debris (as represented by surface fuels greater than 12 inches in diameter) within snag retention areas, untreated areas (as represented under the no-action alternative) and treatments units (including RHCAs), are shown in Table 5.1 (taken from tables 4.12 of Tompkins 2009).

Table 5.1 Issue Indicator Measures for coarse woody debris amounts and recruitment

	Alternative A	Alternative C & D	Alternative E
Avg. Tons/Ac of Large woody debris (short-term: Post-harvest)	within treated areas: 1.1 - 4.3 within snag retention areas: 0.5	within treated areas: 1.1 – 1.3 within snag retention areas: 0.5	with in treated areas: 1.1 – 1.3 All other areas: 0.5
Avg. Tons/Ac of Large woody debris (long-term: 30 years)	within treated areas: 0.8 – 10.8 within snag retention areas: 12.4	within treated areas: 0.8 – 4.4 within snag retention areas: 12.4	within treated areas: 0.8 – 4.4 All other areas: 12.4
Avg. number of snags > 15" available for large woody debris recruitment to streams (Short-term: Post-harvest)	4 - 6 snags per acre in treated RHCAs	4 – 6 snags per acre in treated RHCAs	>15.6 snags per acre

Table 5.2. LWD values in tons per acre average in treatment units—summarized from fire ecology modeling and stand exam data (Tompkins 2009).

Term	All Action Alternatives	All Action Alternatives	Alt. A Only	RHCAs	
	Tractor and/or Roadside Hazard Units LWD > 3" diameter	Tractor and/or Roadside Hazard Units, LWD > 12" diameter	Helicopter and Skyline Units LWD > 3" diameter	Tractor and/or Roadside Hazard Units LWD > 3" diameter	Helicopter and Skyline Units LWD > 3" diameter
Post-Harvest	7.3	1.1	7.3	7.8	10.4
10 years after harvest	6.7	1.0	14.7	12.4	17.3
20 years after harvest	6.2	0.9	18.8	12.8	23.1
30 years after harvest	5.6	0.8	18.5	11.8	22.8

All standing dead under 16 inches dbh will be left in the helicopter and skyline cable units in Alternative A, therefore recruitment for LWD is greatest within these. Because of biomass removal of standing dead below 16 inch dbh, and harvest of standing dead above 16 inch dbh, LWD amounts in salvage tractor units are estimated to decrease in time from 7.3 tons per acre on the average to 5.6 tons per acre on the average 30 years after the fire (Table 5.2). There will be some recruitment from those fire damaged trees that will die 3 to 5 years after the fire. In treated areas of tractor units, aside from wildlife snag retention stands and equipment exclusion zones in RHCAs, LWD amounts will not

meet standards set in the amended forest plan (USDA 2004a, page 23 in Moser 2009). There will be some recruitment from retention of four of the largest snags per acre within falling distance of perennial and intermittent streams (Thompkins 2009).

It should also be noted that silvicultural guidelines specify harvest of fire-killed trees only. Post-fire mortality of fire-injured trees, particularly within moderate and high vegetation burn severity areas, would occur in the first three to five years immediately following the fire event. Snag recruitment and coarse woody debris recruitment would continue to occur within these areas as well. The current estimated snag densities on National Forest System lands within the analysis area is shown in table 53 of the RDEIS.

Erosion from harvest slopes, and subsequent sediment delivery to channels is expected to be elevated over normal conditions because of lack of ground cover. But in the event of precipitation that initiates erosion the overall lack of ground cover on burned slopes would be the greater source. Harvesting creates areas of compaction and displacement of soils, leading to localized incidences of overland flow, but BMPs, PNF LRMP guidelines and regional soil productivity guidelines would limit detrimental disturbances to soil to 15 percent or less of a treatment unit. The treatment units do not constitute the majority of slope area. Therefore actual harvest effects are a relatively minor proportion of the watershed, as shown in Table 58 (Moser 2009).

Theoretically, tractor yarding would have the greatest impact with removal of cover from 15 to 30% across units due to machine travel on bare soils. On severe burn areas, loss of cover would be smaller but salvage harvest during the first year of harvest would set back recovery none the less. Steep areas would have groundcover reductions of 3 to 10% depending on the harvest system. Helicopter yarding usually leads to <3% detrimental disturbance and skyline yarding averages 10% detrimental disturbance (McIver and Starr 2000). Thus, tractor harvest, would delayed recovery compared to skyline systems when compared to natural wildfire recovery rates.

The bulk of the harvest, particularly the tractor harvest is concentrated in the Lights Creek drainage, and even more so in headwater streams that confluence in a single locale at the top of the Middle Lights Creek watershed. These watersheds are upper lights Creek, West Branch and East Branch of Lights Creek, Smith Creek and Morton Creek. In addition, a significant proportion of proposed harvest is in the Moonlight Creek drainage, which confluences with Lights Creek at the bottom end of the Middle Lights Creek watershed. Further, the Middle Lights Creek is an epicenter of sorts for burn severity (Moser 2009). Without ground cover and canopy cover there is very little effective buffer for the RHCA's.

In the helicopter and skyline cable units, because of the lop and scatter of limbs and tops, and the leaving of trees under 16 inches dbh, the resultant ground cover immediately after harvest is likely to be better than in any RHCA that these units may include. The same is not true for ground-based units which will transport most of the standing dead material out. There will be some amount of breakage that will be left on the ground, but this volume would be far from predictive. In addition, because of biomass prescription, it is likely wheeled equipment would travel over most of a unit area. About one third the total

acres in RHCA along perennial channels and intermittent channels are on ground with high to very high EHR (see discussion in RFEIS, pg. 178 - Affected Environment; Soils) and are adjacent to proposed ground base operations (Moser 2009).

Cumulative Effects to Habitat in the Analysis Area.

Table 1 – ERA values within Subwatersheds by Alternative

Watershed	ERA% Alternative				Total ERA %				
	Alt. A	Alt. C	Alt. D	Alt. E	Existing*	Alt. A	Alt. C	Alt. D	Alt. E
Bear Valley	0.0	0.0	0.0	0.0	23.0	23.0	23.0	23.0	23.0
Cold Stream	1.1	0.9	0.3	0.3	13.6	14.7	14.5	13.9	13.9
East Branch Lights C.	3.0	2.9	1.9	1.8	16.6	19.5	19.4	18.4	18.4
Freds C.	0.2	0.0	0.0	0.0	12.5	12.7	12.5	12.5	12.5
Indian C. blw Antelope-Babcock	1.9	1.0	0.2	0.0	19.7	21.5	20.7	19.9	19.7
Indian C. blw Antelope-Dam	0.5	0.4	0.0	0.0	14.6	15.1	15.0	14.6	14.6
Lonesome Canyon	0.4	0.2	0.1	0.0	26.7	30.1	29.9	29.8	29.7
L. Cooks C.	0.3	0.3	0.2	0.2	5.9	6.2	6.2	6.1	6.1
L. Indian C.	1.6	1.6	1.6	1.2	15.8	17.4	17.4	17.4	17.0
L. Lights C.	0.6	0.1	0.1	0.1	17.4	18.0	17.5	17.5	17.5
L. Lone Rock C.	1.4	1.0	0.8	0.5	15.4	16.7	16.4	16.2	15.9
Middle C.	0.9	0.6	0.3	0.3	12.3	13.2	12.9	12.6	12.6
Mid. Hungry C.	1.1	1.0	0.6	0.4	8.8	9.9	9.8	9.4	9.2
Mid. Lights C.	3.0	1.5	1.0	0.9	19.9	22.9	21.3	20.9	20.8
Moonlight C.	1.2	0.7	0.6	0.6	14.5	15.7	15.2	15.1	15.1
Moonlight Pass	0.1	0.0	0.0	0.0	22.8	22.9	22.9	22.9	22.9
Moonlight Valley	1.9	1.7	1.4	0.8	18.0	19.9	19.8	19.5	18.8
Morton C.	1.0	0.9	0.6	0.4	21.8	22.8	22.8	22.5	22.3
North Arm Indian Valley	0.1	0.1	0.1	0.1	4.7	4.8	4.8	4.8	4.8
Pierce C.	0.8	0.8	0.8	0.6	9.6	10.3	10.4	10.4	10.2
Smith C.	1.4	1.3	0.9	0.3	25.3	26.7	26.6	26.2	25.6
Up. Hungry C.	1.4	1.4	1.3	1.3	12.2	13.6	13.6	13.5	13.5
Up. Indian C.	1.5	1.4	0.8	0.5	10.2	11.6	11.5	11.0	10.7
Up. Lights C.	0.3	0.1	0.1	0.1	14.1	14.3	14.2	14.2	14.2
Upper Peters Creek	0.5	0.5	0.5	0.5	10.5	11.1	11.1	11.1	11.1
West Branch Lights C.	3.5	2.7	1.2	1.1	21.2	24.7	23.9	22.4	22.3

Cumulative Effects to Habitat in the Project Area. Past, present, and reasonably foreseeable future actions affecting the habitat in the analysis area have been identified in the project RDEIS (Appendix B).

Two roadside safety and hazard tree removal projects (Antelope Complex on the Mt. Hough Ranger District and Dry Flat on the Beckwourth Ranger District) were implemented in 2008. These two projects removed hazard trees from approximately 3,330 acres. The Antelope Complex project was the only project of these two to enter and treat an existing HRCA for roadside hazard tree removal. This occurred in the HRCA for PL167 and approximately 13 acres were treated.

There are two additional Forest Service projects currently being planned that would remove fire-killed trees within the analysis area. The Camp 14 and North Moonlight projects are fire salvage projects proposed by the Beckwourth Ranger District, Plumas National Forest, and the Eagle Lake Ranger District, Lassen National Forest, respectively. The Camp 14 project is completed while the North Moonlight project is currently under contract and ongoing. These fire salvage projects are limited to less than 250 acres in size, and occur in separate watersheds. Both of these projects include harvesting fire-injured trees in the interest of capturing the value of those trees which were substantially injured by the fire and likely to die in the near future; however, since these projects also primarily target areas of high to moderate burn severity where greater than 50 percent of the basal area was killed, most trees harvested would be dead, fire-killed trees. The contributions of these two projects to cumulative effects include a localized reduction in snags, in snag recruitment from fire-injured trees, and in high burn severity forest structure. These two projects would affect 0.7 percent of public lands within the analysis area and represent the smallest contribution towards cumulative effects to forest vegetation, fuel loading, fire behavior, or air quality within the analysis area. Due to the size, scale, and, in the case of Camp 14, the dispersal of such activities, these localized effects would be minimal when considering the extent of the analysis area.

Reforestation of national forest lands where no salvage harvest is proposed began within the analysis area in spring 2008. A combination of low density wide spaced cluster planting in the Antelope Lake and Babcock Peak areas and low density square-spaced planting in the Camp 14 area occurred within areas of high fire severity accounting for a total of approximately 838 acres planted in 2008. During the summer of 2008, the Frazier Cabin Reforestation Project included 141 acres of mechanical site preparation which accounts for 0.16 percent of the analysis area and consequently results in a negligible contribution to cumulative effects. Approximately 10,500 acres of high severity, unsalvaged areas were planted in Spring 2009 across the Mt. Hough and Beckwourth Ranger District portions of the Moonlight and Antelope Complex fires utilizing a combination of low density planting arrangements. These additional acres of reforestation occurred in unsalvaged areas of the fire including old plantations and natural stands. Manual release treatments would occur within one to two years following planting. The net cumulative effect would be the enhanced establishment of conifer seedlings across the analysis area in order to re-establish forested conditions.

Private lands account for over 19,000 acres or approximately 22 percent of the analysis area. Since fall 2007 through the present, fire salvage harvest has been occurring on these lands. Approximately 4,073 acres were planned for salvage harvest in 2007 and fire salvage timber harvest plans filed to date in 2009 account for an additional 7,381 acres approximately. Based on current activity, private fire salvage projects occur mostly on productive, well-stocked stands that burned with moderate to high burn severity resulting in a notable reduction in densities of fire-killed and fire-injured trees on private lands. It is reasonably assumed based on state forest practice regulations and private timber practices that these areas would be re-planted and managed for maximizing tree growth.

The analysis area occurs within the boundaries of nine active livestock grazing allotments, the majority of which is composed of the Clarks Creek, Lights Creek, and

Lone Rock allotments. Grazing capacity within allotments is based on the primary range (meadow systems) and not on secondary or transitory range. At this time there are no plans to increase livestock stocking rates or use due to the increase in transitory range created by the fire. Based on the existing stocking rates and current range conditions, the season of use, the distribution of primary range across the analysis area, as well as no increased stocking due to increase in transitory range, there should be no change in livestock effects to habitat conditions over the long term (5+ years).

Within the nine active grazing allotments in the fire perimeters there is expected to be minimal impacts to critical riparian areas due to the following reasons: 1) cows did not graze burned areas in 2008, the season after the wildfires, therefore riparian vegetation have had a full year of rest to resprout, 2) the increase in transitory (upland) range 2-5 years after the fires may take some grazing pressure off of the meadows and riparian areas with a flush of dryland grass/forbs that livestock may find palatable, and 3) long term recovery will be unimpeded through strict adherence to use standards which are: 20% willow use, 20% aspen use, 20% bank alteration, and 50% meadow use. Cows are removed from the pasture when any one of these triggers are reached. In addition, the Lower Lone Rock Creek watershed, which supports a well distributed population of MYLF's on Forest Service land, is scheduled to have a 1.5 mile temporary electric fence constructed in spring, 2009, before the cattle are turned out, which will prevent grazing in that reach of the watershed, further allowing riparian vegetation and streambanks to recover.

The wildfire left the landscape in a very risky condition for flooding and slope erosion within the next two to three years as slopes revegetate. The effects of the action alternatives are difficult to measure compared to larger issue of recovery after the wildfire (fig.1, table 1) (Moser 2009). It should be noted that "the confluence of similar third order watersheds at the top of Middle Lights Creek watershed creates in itself a heightened risk for flooding on and downstream of this watershed. Cumulatively with the heavy logging on Sierra Pacific lands in the headwaters of Upper Lights, West and East Branch Lights and Smith Creeks, the principle contributors to Lights Creek. Altogether these factors create a "perfect storm" condition for flooding during the occurrence of a warm southwestern in mid winter that brings heavy rains and warm winds on a thick blanket of snow" (Moser 2009).

Cumulative Effects Conclusion: The direct/indirect and cumulative effect of fire-killed or hazard tree removal and reforestation would not change the existing amount of riverine or lacustrine habitat, would not change the amount of montane riparian habitat present in the analysis area, would not result in any reduction in deciduous canopy closure, or result in a change in size class of existing riparian vegetation. There may be instances where individual live trees may be cut for safety purposes or to facilitate access to harvest fire-killed trees. These instances are expected to be rare and impacts to existing live tree stands minimal. Therefore, the project would not reduce the amount of total live tree canopy.

The watershed report (Moser 2009) concluded that given implementation of erosion control features in activity areas, and observations of stream buffer effectiveness, impacts to water quality from activity disturbed ground are not expected to be a significant factor

in the event of precipitation that induces overland flow in the burned watersheds. The slight amounts of sediment generated from activity areas during a high runoff event over the burned landscape would not be measurable or detectable at the analysis watershed scale and would not affect identified downstream beneficial uses, including habitat occupied by macroinvertebrates.

Alternative B (No Action)

Direct and Indirect Effects to Habitat.

As salvage logging may extend the timeframes for in-stream habitat recovery and restoration of the macroinvertebrate community, the no action alternative, may reduce the timeframe for this recovery. There would be no short-term reduction in macroinvertebrate habitat above that affected by wildfire. Flows and sedimentation would still increase, and surface water shading would still be minimal, due to lack of vegetation caused by wildfire.

In the long term, no fuels treatment would leave habitat vulnerable to high severity wildfire in the future, increasing the risk of a large downstream hydrologic event reducing the quality of habitat for macroinvertebrates.

Cumulative Effects to Habitat in the Project Area. Additional projects within the analysis area that would remove fire-killed or hazard trees and implement reforestation would continue. Livestock grazing, as described above under the cumulative effects section of the action alternatives, would continue. Changes in flow, water surface shade will be too small to be measured. Sedimentation is expected to increase as a result of vegetative removal caused by the wildfire. There would be no logging thus the risk of additional sediment delivery to the riverine systems is minimal.

Cumulative Effects Conclusion: There would be no direct/indirect or added cumulative effect, as no logging of fire-killed or hazard trees would occur. No reforestation would occur. Less long term restoration/recovery occurs with this alternative over the analysis area than with the action alternatives, therefore timeframes for recovery of in-stream habitat may be reduced.

Evaluation of Elements

Flow: Streams within the Moonlight/ Wheeler Aquatic Analysis area are not expected to change flow due to the no Action alternative (Alt. B) . For example all perennial streams are expected to remain perennial, all intermittent streams are expected to remain intermittent and the same for ephemeral streams. Flow will change depending on the water year. There would be no change in the TOC/ERA values by the implantation of alternative B (table 1) and the greatest effect to flow will be within those twenty-one of the twenty-six subsheds analyzed that are currently over threshold post fire and will remain over threshold. With a high water event there would be potential for a debris flow to occur within the stream courses in those sub-watersheds (Table 1). There are twenty-

four perennial streams within the aquatic analysis area. The streams of concern are discussed above.

Temperature: Stream temperature would remain the same as the existing post fire condition. With the high fuel loading there would be a greater potential of another castrophic wildfire within these perennial and intermittent drainages, thus with a future potential of affecting the timing of life history activities of sensitive taxa.

No trees would be planted within the project area and thus the opportunity to provide shade within the RHCA's and to recover the land post fire will take considerably longer. Natural recovery would occur. Snags provide structure and some cover into the future, yet recovery of the conifers and the associated shade they provide within the RHCA would be delayed into the future.

S*ediment:*

Sedmentation rates into the perennial and intermittent drainages will remain the same post fire condition. TOC values will remain the same. The RIV PAC's score should remain the same, unless a high water event or rain on snow event occurs within the sensitive watersheds.

Issue Indicator Measures for coarse woody debris amounts and recruitment

	Alternative B
Avg. Tons/Ac of Large woody debris (short-term: Post-harvest)	All areas: 0.5
Avg. Tons/Ac of Large woody debris (long-term: 30 years)	All areas: 12.4
Avg. number of snags > 15" available for large woody debris recruitment to streams (Short-term: Post-harvest)	>15.6 snags per acre

Again, reference Table 4.13 of the Vegetation Report (Tompkins 2009) for the tons per acre of LWD modeled to be retained within the treatment units by alternative.

Snag recruitment and coarse woody debris recruitment would continue to occur within the analysis area. There would be a greater number of snags into the future without the implementation of the actions alternatives. Fuel loading would be very high and increase the potential for a catastrophic wildfire without any treatment or fuel removal within the project boundary. .

Relationship of Project-Level Habitat Impacts to Bioregional-Scale Aquatic Macroinvertebrates Habitat Trend. Again, in the short term, based on the direct/indirect and cumulative effects of the action alternatives as well as the no action alternative, the status and trend of in-stream habitat and the macroinvertebrate community would be negatively impacted for the short term, but long term restoration and recovery would occur 10-50 years out. This impact could occur in approximately 10+ miles of perennial streams within the project area. These short term impacts at the project

level are too small to have any affect at the larger scale and thus will not alter the existing trend in the habitat or aquatic macroinvertebrates across the Sierra Nevada bioregion."

Regional Trend

Overall, the collection of condition scores reveals that there are many sites in very good-to-excellent condition, since their O/E scores are near unity (i.e., the species of aquatic macroinvertebrates observed to occur at many sites closely matches those expected to occur at a site that is unimpaired). However, the sites sampled were specifically chosen because they generally represented the best sites available on each forest and data from them cannot be related confidently to broader scales for assessment of condition and trend. However, samples taken in future years at these sites will allow us to assess condition and trend at scales from stream reach up to watersheds of thousands of acres.

Table BMI-1. Summary of existing BMI bioassessment data from the Sierra Nevada national forests.

Forest	Number of Sites	Samples Collected What Years	Mean Watershed Area (acres)	Range in Watershed Areas (acres)	Mean RIVPACS O/E Score	Range in RIVPACS O/E Scores
Eldorado	10	2000-01	4,426	670 - 13,523	1.04	0.76 – 1.24
Inyo	9	2000-02	4,112	1,429 – 8,192	0.95	0.87 – 1.12
Lassen	18	2000	9,996	215 – 67,748	1.02	0.61 – 1.27
LTBMU	17	2000-01	3,054	263 – 10,905	0.89	0.58 – 1.16
Modoc	14	2000-01	82,176	1 – 913,982	0.81	0.67 – 1.34
Plumas	14	2000-05	67,244	1,262 – 564,652	0.92	0.57 – 1.26
Sequoia	8	2000	3,009	3 – 5,506	1.05	0.77 – 1.20
Sierra	10	2000-01	22,135	640 – 167,029	0.93	0.78 – 1.30
Stanislaus	14	2000-01	21,535	585 – 92,806	0.90	0.77 – 1.23
Tahoe	15	2000-01	11,429	480 – 87,939	0.93	0.59 – 1.26
Total	**130**	**2000-05**	**23,686**	**1 – 913,982**	**0.95**	**0.57 – 1.34**

Note: O/E = BMI-V.

Population Status and Trend Summary for the Sierra Nevada National Forests.

Current data from the Sierra Nevada indicate that status and trend in the RIVPACS scores is stable.

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Appendix A -

Table 1. Summary of streams and stream condition inventory data (as available) for the Moonlight-Wheeler project area[1]

Table _1__SCI Reaches/Moonlight-Wheeler Fire Restoration

Stream Reaches	Overall Rating[2]	D50 Pebble (mm)	Peak Temp (C)	Pool Tail Fines <2mm (mean)	% Unstable (mean)	% Shade (mean)
Lower Moonlight						
1998	Moderate	n/a (Bevenger)	-	9	49	64
2000	Good	n/a (Bevenger)	-	3	31	70
2001	Moderate	30	19.23	7	43	80
2005	Moderate	38.4	22.7	6.03		
Boulder Creek@Hallet						
2001	Poor	64	23.12	50		
2004	Moderate	22.6	-	20.76		
Cold Steam						
2002	Moderate	<2mm	18.41	73.5		
Hungry Creek						
1998	-				75	81
2001	Moderate	28	20.74	28	29	90
Clarks Crk[1]						
2003	Low	21	32	39.57	65	18
2006	Low	36.21	27.99	34.97	68	
2007	Low	17.71	32.74	29.14		
Little Antelope						
2000	-	<2mm	-	77		
2003	Moderate	5.6	20.85	51		
2005	Low	<2mm	20.16	96.9		
Pierce						
2003	Low	3.5	22.82	89.7		

[1]Clarks Creek can be dry by about mid July

[2]Criteria for overall rating developed by Forest Specialists (Roby et al., 2005)

Appendix B – Macroinvertebrate Observed/Expected Ratio's

Table 1

		P > 0.0	
Stream	O	E	O/E
Boulder Creek (yr?)	23	30.7	0.75
Boulder (Hallet) 2001	22	30.33	0.73
Antelope (yr?)	14	29.96	0.47
Coldstream 2002	27	28.27	0.95
Hungry 2001	29	30.36	0.96
ADD for other streams			

Note: Measures of taxonomic completeness are based on estimates of the difference between observed (O) And expected (E) taxonomic composition. O=taxa (bug diversity) found in survey sample on site, E= taxa (bug diversity) collected in reference stream (in 2000 & 2001 [streams in good condition within watersheds with minimal human disturbance has high biological integrity, and found a similar temperature, and a watershed at a similar latitude]) A O/E value near 1.0 implys high integrity and a value <1.0 implies biological degradation.

TABLE 2

Macroinvertebrate metrics_Data Collected by Plumas NF

Abundance data is the estimated number per square meter for quantitative samples

Stream	Overall Rating[1]	Sampling Date	Total OTU Richness	Total Abundance	Shannon Diversity	EPT Taxa	of most dominant taxa	Oligochaeta Abundance	
NAME		SAMPDATE	RICH	ABUNDANCE	SHDIVER	EPTT	DOMPERC	OLIGA	
Antelope Creek	Mod -Good	9/15/1998	37	2199	2.912	18	16.28	0	7
Antelope Creek	Mod-Good	9/15/1998	41	4387	2.838	21	21.97	2	1
Antelope Creek	Mod-Good	9/15/1998	36	4647	2.691	21	20.36	0	1
Moonlight Creek	Low-Mod	8/31/1998	36	12210	2.211	22	43.68	0	1
Moonlight Creek	Low-Mod	8/31/1998	39	5577	2.468	22	31.61	0	5
Moonlight Creek	Low-Mod	8/31/1998	30	9860	2.234	14	41.00	0	2
Boulder Creek	Mod-Good	8/5/1998	42	2812	2.948	28	16.25	0	7
Boulder Creek	Mod-Good	8/5/1998	31	3496	2.509	15	25.14	48	7
Boulder Creek	Moderate	8/5/1998	32	1411	2.318	23	46.56	5	1
Hungry Creek	Good	8/6/1998	44	3156	2.912	28	16.25	0	7
Hungry Creek	Good	8/6/1998	37	2724	2.775	27	28.23	0	2
Hungry Creek	Mod-Good	8/6/1998	36	8993	2.843	25	18.51	0	2
Last Chance Creek	Mod-Poor	7/8/1998	16	229	1.573	6	61.14	2	1
Last Chance Creek	Poor	7/8/1998	9	1842	1.071	4	71.93	0	1
Last Chance Creek	Poor	7/8/1998	18	1455	1.575	8	60.55	0	1
Clark's Creek	Poor	6/22/1998	19	118	2.321	8	34.75	0	4
Clark's Creek	Poor	6/22/1998	13	109	1.766	4	34.86	2	3
Clark's Creek	Poor	6/22/1998	12	77	1.831	4	41.56	0	3
Last Chance Creek	Poor	8/2/1999	10	985	0.789	0	78.27	0	8
Last Chance Creek	Poor	8/2/1999	15	1410	1.080	2	68.16	32	1
Last Chance Creek	Poor	8/2/1999	20	2758	0.974	8	77.37	11	2
Little Antelope Creek	Poor	7/24/2000	34	7514	2.008	16	45.58	287	4
Boulder Creek	Mod-good	8/9/2000	45	2299	2.554	24	33.54	21	1
Antelope Creek	Mod-good	7/19/2000	36	2758	2.104	21	40.39	0	8
Moonlight Creek	Moderate[1]	8/24/2000	45	5591	2.627	24	26.20	0	1
Boulder Creek	Moderate[2]	6/21/2001	43	7484	2.736	24	30.32	14	3
Boulder Creek at Hallet Meadows	Moderate[2]	8/8/2001	42	17690	2.480	24	32.35	0	8
Hungry Creek	Good[2]	7/19/2001	56	23237	3.116	36	16.71	0	5
Moonlight Creek	Good[2]	7/18/2001	47	34742	2.903	27	24.75	57	1
Coldstream Creek	Good[2]	8/28/2002	58	51351	2.665	38	35.97	79	2
Indian Creek	Good	8/4/2003	43	900	2.833	29	30.67	0	6
Clark's Creek	Moderate	6/23/2003	29	5489	1.781	9	41.39	0	3

SHDIVER	Shannon Diversity, calculation considers richness, and the evenness with which the organisms are spread among the taxa, as richness decreases, the number goes down. Values: 1.5=Poor, >=2.8=Good Mod - Poor SCHDIVER
EPTT	The no. of Mayfly, Stonefly, Caddisfly taxa. Generally more sensitive, as neg.impact occurs, value decreases
DOMPERC	% of macroinvertebrates in the most dominant taxon.If one bug represents 50% of all bugs in sample, value=.5

%CHI	Chrionomidae (midge flys) abundance. Dhir's are very tolerant and like sediment and disturbed systems, value increases ir , impaired systems with high fine sediments. In addition, meadow streams are prone to high sediment values.
% OLIGA	Oligochaetadae (aquatic worms), like Chironomidae, Olig's are very tolerant and like sediment and disturbed systems

[1]The criteria to develop the overall rating values were developed though a process by Forest Specialists on the Lassen and Plumas NF (Roby et al. 2005).
[2]Streams with high Chrionomidae levels